CHARACTERIZATION OF BELGIAN MARINE HEATWAVES AND THEIR IMPACTS ON PLANKTON DYNAMICS

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In aquatic ecosystems, plankton communities generally form the base of trophic webs, and environmental changes are often reflected, or even amplified, in these communities. In the context of anthropogenic climate change, plankton communities could be drastically impacted by rising temperatures and the increase of extreme climate events. The Belgian Part of the North Sea (BPNS) is already heavily influenced by human activity, and extreme climate events could greatly alter the dynamics of the ecosystem. Recent years have seen an uptick in marine heatwaves in the BPNS, which have been associated with unusually prominent *Bellerochea* sp. blooms and temporary copepod die-offs. As the frequency of these marine heatwaves is projected to increase, it is necessary to gain an understanding of how phytoplankton and zooplankton communities may respond not only to stable temperature change, but also to rapid change. This research therefore aimed first to characterize BPNS marine heatwaves, and second to analyze the corresponding plankton community dynamics. Initially, 30 years of satellite data were used from the National Oceanic and Atmospheric Administration Optimum Interpolation Sea Surface Temperature dataset (NOAA OI SST V2 High Resolution Dataset). Temperature data was used to establish a 90th percentile threshold for marine heatwave detection. Marine heatwaves were then characterized based on intensity relative to the 90th percentile threshold, cumulative intensity (deg. C x days), duration, peak temperature reached, and timing of peak temperature. These results were compared with those from underway temperature measurements at ~3 m depth as well as with CTD temperature measurements, all collected on the RV Simon Stevin. Additionally, we defined and analyzed temperature regions based on both geographical and biological zones. For plankton data, samples were collected monthly (nine coastal stations) and seasonally (with eight additional offshore stations) on board the RV Simon Stevin, with zooplankton data from 2014 onwards and phytoplankton data from 2017 onwards. ZooScan and FlowCam automated imaging sensors were used to quantify zooplankton and phytoplankton, respectively. Plankton dynamics were then analyzed in terms of bloom timings and abundances (dominant groups, diversity indices). Overall temperature data from the BPNS showed similar marine heatwave trends using NOAA satellite data and RV Simon Stevin underway data, and highest temperatures were reached in the summers of 2018 and 2022. At several nearshore stations, the key plankton group Appendicularia had a delayed bloom during the 2022 marine heatwave compared to the 2018 marine heatwave. Ultimately, this parallel characterization of marine heatwaves and plankton dynamics offers insight into the health of the BPNS ecosystem. Furthermore, it offers potential for predicting the responses of phytoplankton and zooplankton to future marine heatwave events.

Keywords: Plankton ecology; Climate change; Heatwaves; Plankton imaging

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